Evaluation of the Relationship between Electric Conductivity and Spectral Index for Soil Salinity Mapping of Rice Paddy Field in Khon Kaen Province

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Background

- Salt-affected soil is widely distributed in Northeast Thailand.
- Salt-affected soil causes low rice productivity.

To understand Geospatial distribution of the degree of salt injury is required for land management in this region.

LDD already havs salt-affected soil map based on coverage of salt crust in the middle of dry season.

Class	Description
1	salt crust **> 50%** of the soil surface
2	salt crust **> 10-50%**
3	salt crust **> 1-10%**
4	salt crust **> 0-1%**
5	no salt crust but underlain with salt rocks
6	salt free areas

Class 1 **Class 2**

Class 3 **Class 4**

Classification criteria of this map was not based on the index directly related to crop growth (such as electrical conductivity).

Objective

As the first step of soil salinity mapping based on the index directly related to crop growth at regional scale using spectral information,

- **Relationship between the index related to crop growth before planting and amount of rice body during growth period**
- **Availability of salinity index derived from remotely sensed data in dry season**

were evaluated.

Study area
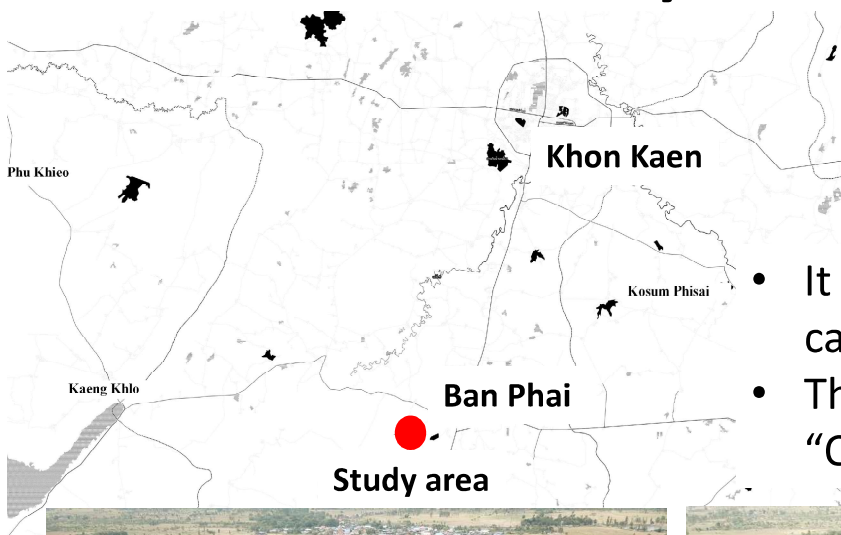
- It is approximately 1 hour by car from Khon Kaen city.
- This area is classified as "Class 2".

Materials

Electrical Conductivity by saturated extraction method (ECe) and Soil moisture Content (SMC)

- Soil sampling was conducted on **6-7 April 2016, from October 2016 to December 2017** at the study area.
- To calculate ECe and SMC value, soil samples were analyzed by LDD.

Leaf Area Index (LAI)

- To evaluate amount of rice body, LAI was measured during **6-8 September 2016** by plant canopy analyzer (LAI-2200, Li-cor).

LAI-2200

Sequoia

Specrtal Image

- To generate salinity index map, multi-spectral images were obtained on **22 December 2016 and 11 May 2017** by multi-spectral camera (Sequoia, Parrot) on drone (Solo, 3DR)

Solo

Analysis Procedure

1. Relationship between **ECe before planting and LAI during growth period** was evaluated.

2. Relationship between **ECe and Normalized Difference Salinity Index (NDSI)** on the same day in dry season was evaluated.
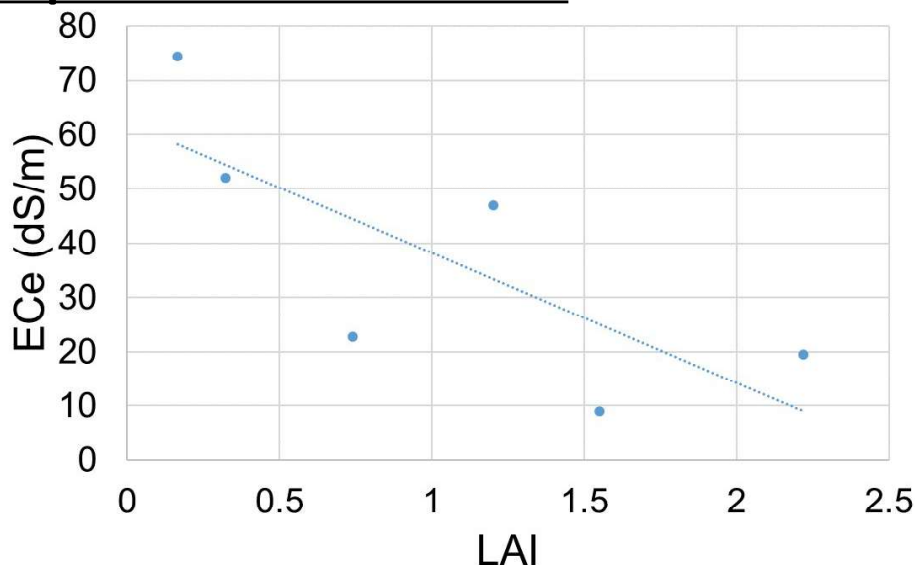
$$NDSI = \frac{(RED-NIR)}{(RED+NIR)}$$

RED: Reflectance of the wavelength in red region
NIR: Reflectance of the wavelength in near-infrared region

3. Relationship between **NDSI and SMC** on the same day was evaluated.

4. Relationship between **ECe and SMC** on the same day was evaluated.
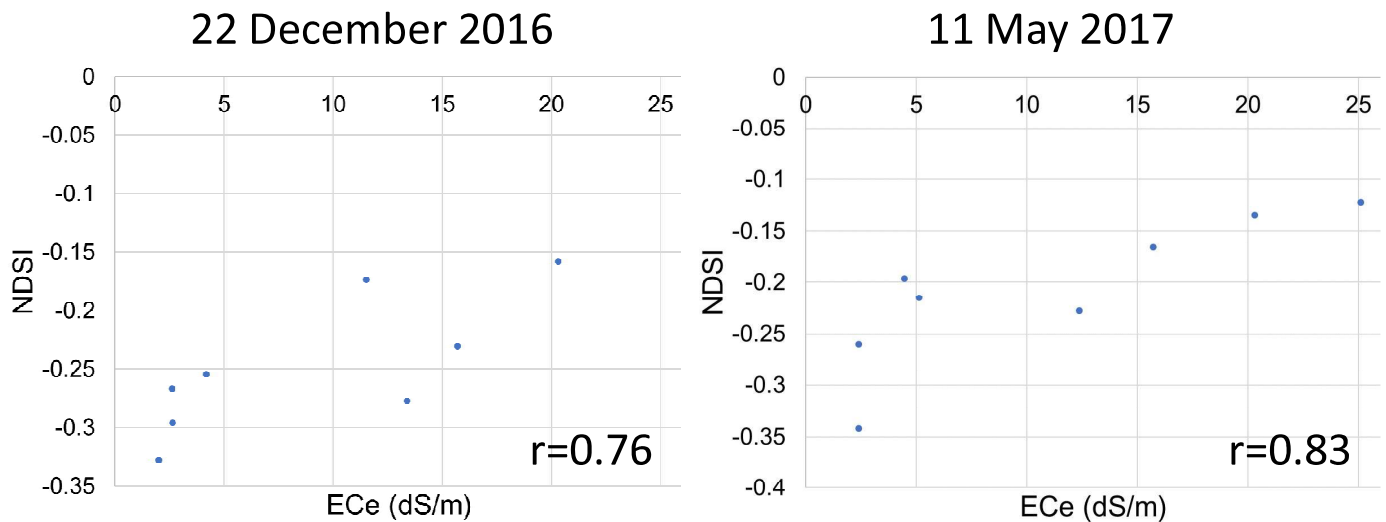
Results

Relationship between LAI and ECe

There is **negative correlation** between ECe before planting and LAI during growth period (r=-0.75).

Growth amount was lowered where the values of ECe was high before planting (dry season).

Relationship between ECe and NDSI
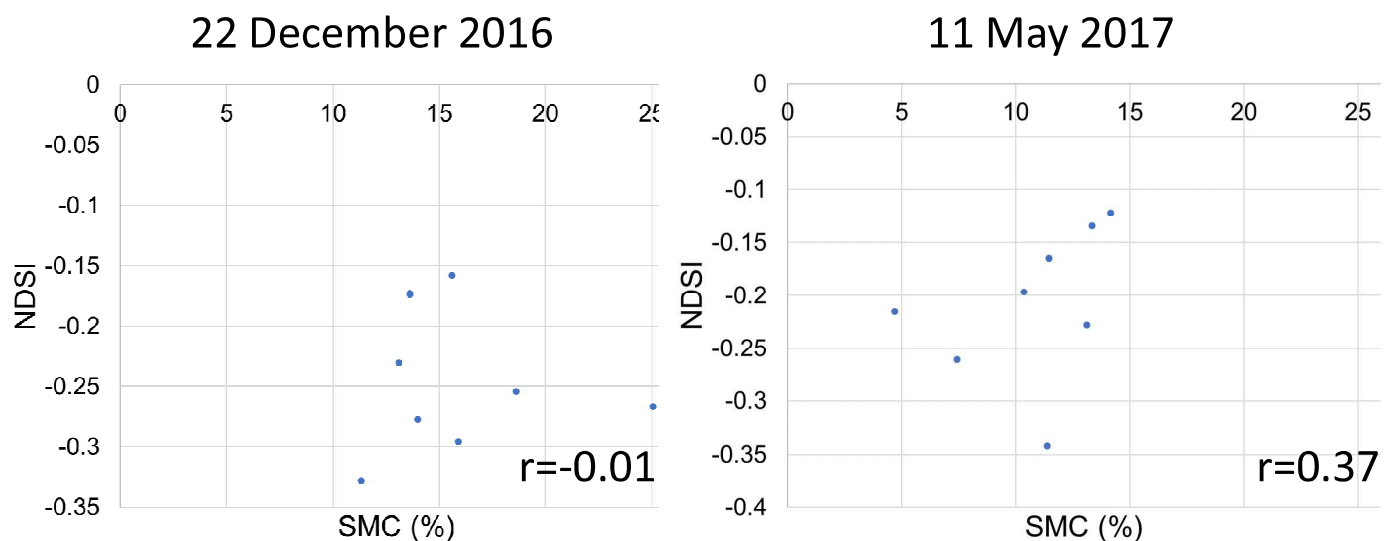
22 December 2016

11 May 2017

There are **positive correlations** between ECe and NDSI before planting period in dry season.

NDSI has a potential to estimate ECe before planting period.

Relationship between SMC and NDSI

22 December 2016
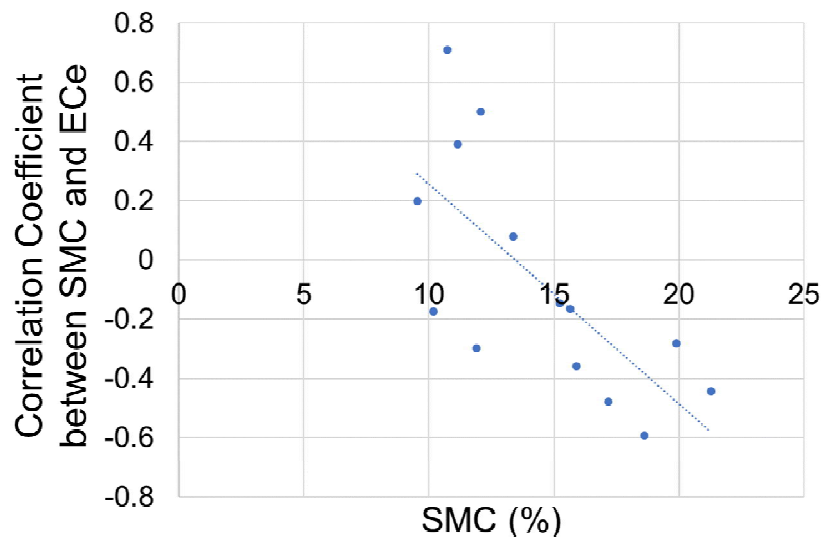

11 May 2017

There is **no correlation** between ECe and NDSI on 22 December, but there is **weak positive correlation** on 11May.

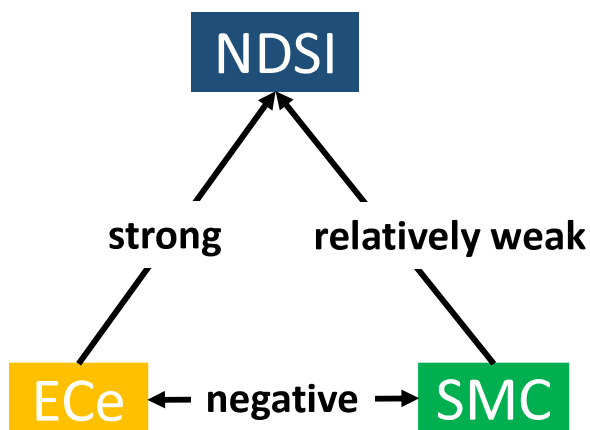**Any factor affects to NDSI-SMC relationship?**

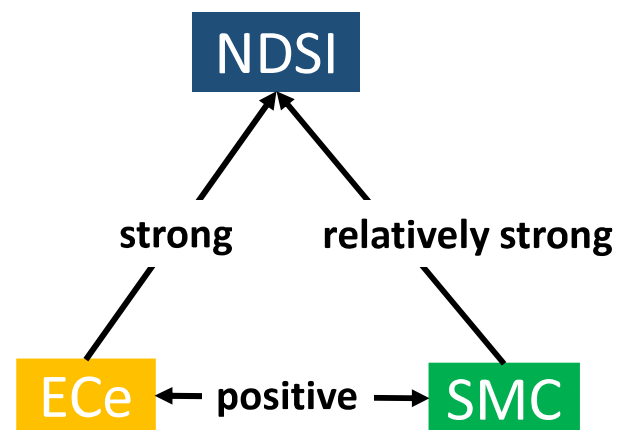# Relationship between SMC and SMC-ECe correlation coefficient

- There is **posivite correlation** between ECe and SMC when SMC value is relatively low.
- There is **negative correlation** between ECe and SMC when SMC value is relatively high.

   Influence of the difference in the characteristics of soil moisture?

   (affected by groundwater? or rain?)

SMC: high

NDSI

strong   relatively weak

ECe ← negative → SMC

SMC: low
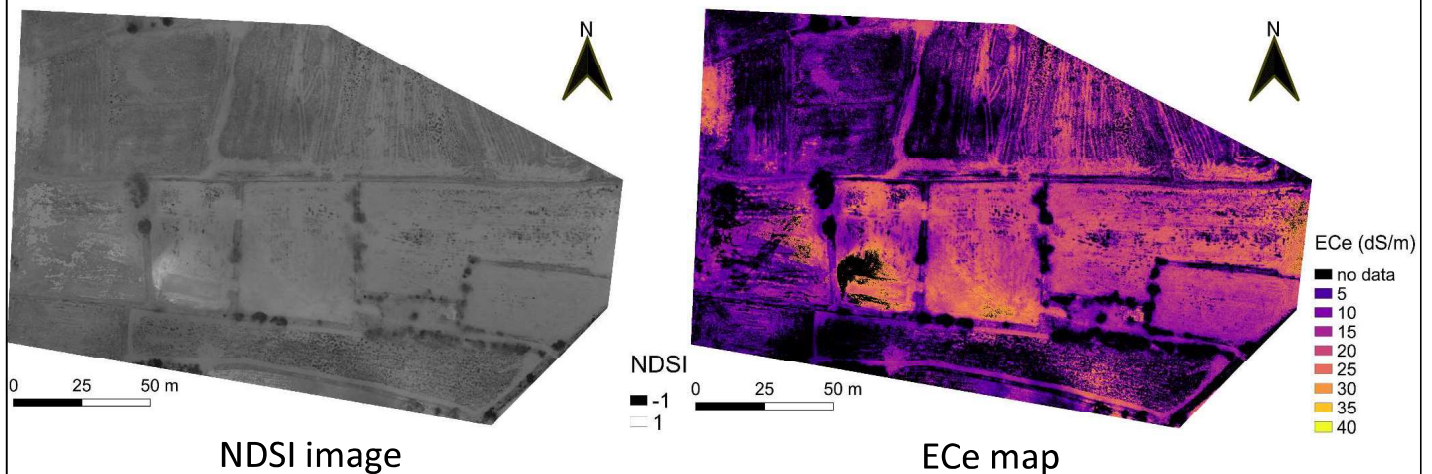

NDSI

strong   relatively strong

ECe ← positive → SMC

- There is **positive correlation** between ECe and NDSI.

- However, **ECe estimation equation by using NDSI might change** when ECe-SMC relationship will change.

Example of ECe map on 11 May 2017 derived from ECe estimatied equation by using NDSI

NDSI image

ECe map

Estimation equation is available only for the data of field measurement day because the equation did not take into account the influence of SMC.

Conclusions

Evaluation of the relationship between LAI during growth period and ECe before planting was conducted.

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Strong negative correlations between ECe before planting and LAI during growth period were confirmed

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Growth is affected by ECe before planting

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Geospatial distribution maps of ECe before planting will be useful for planning of rice planting and growth management after planting.

Evaluation of relationships between ECe and NDSI derived from drone before planting was conducted.

NDSI has positive relationship with ECe. However, **NDSI-ECe relationship might change when ECe-SMC relationship will change**.

To develop the robust estimation method of ECe value using spectral index such as NDSI

- **Influence of soil moisture must be evaluated under moisture conditions.**

- **Influence of soil moisture must be taken into account in the estimation equation.**

Thank you for your attention !!